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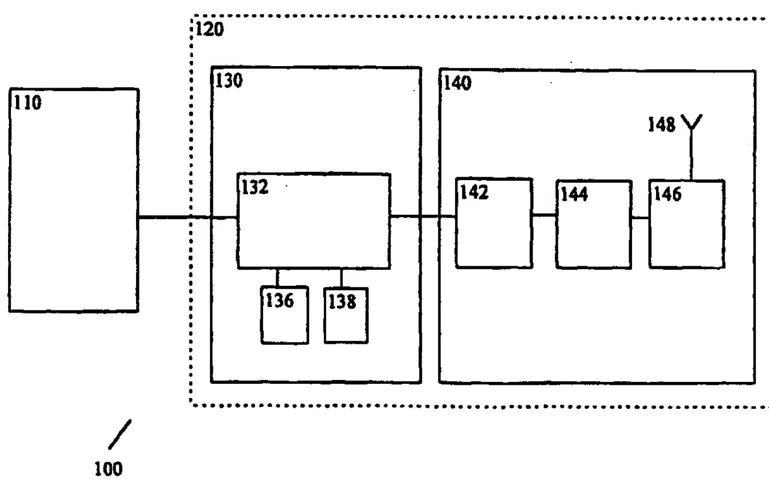
(54) Title: COMMUNICATION DEVICE AND METER READING DEVICE




(57) **Abstract:** The invention relates to dynamic routing in a communication network. This is achieved by means of a communication unit (120), particularly for use in a telemetry network. The communication unit (120) comprises a radio-transceiver (140) and a controller (130) with a memory (136, 138), where the controller (130) is arranged to receive an inquiry message from a second communication unit (120) in the network by means of the transceiver (140) and to decode the inquiry message. The memory (136, 138) contains position data concerning the communication unit's (120) geographical position. On decoding the message, the controller is arranged to derive position data concerning an originator's and a destination's geographical positions, and furthermore, on the basis of the position data, to calculate course deviation data representing the distance from the communication unit's own position to a straight line between the originator's and the destination's positions. The controller (130) is further arranged to transmit a response message comprising the said course deviation data back to the said second communication unit (120) by means of the transceiver (140). The invention also comprises a meter reading unit (100) in which the communication unit (120) is included.

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# Communication device and meter reading device

## Technical field

In general the invention relates to radio communication systems, and more specifically radio communication systems using dynamic geographical routing for routing messages through a network. In particular the invention relates to a communication unit, a meter reading unit in which the communication unit is included and a telemetry network in which the meter reading unit is included.

## Background of the invention

Reading of utility meters, such as utility meters for electrical energy, water or gas, has traditionally been carried out manually by a meter reader or by a customer. Recent developments in the competitive situation within the field of energy supplies have resulted in the need for more frequent and simplified procedures for reading such meters. The development in the field of smart house services and alarm services has also led to the need for communication systems for transmitting data between buildings/households or between a building/household and a central unit. It is therefore desirable to provide a flexible and efficient communication unit that can form the basis for the development of such a communication system. It is particularly desirable to provide a communication unit that permits dynamic geographical routing in a network. A communication unit of this kind can form part of a meter reading unit, where a large number of such meter reading units form part of a telemetry network.

## The state of the art

A number of different systems have previously been described for simplified and automated reading of utility meters.

EP-854 557 illustrates that it is previously known to retrofit equipment for optical reading of utility meters for energy, whereupon the reading data are transmitted to a central system, e.g. via the telecommunication network or by means of a radio transmission.

In US 5 874 903 a meter reading network is described composed of meter readers, where each reader comprises measuring equipment, a radio

transceiver and a controller. By means of the controller, each reader is further programmed to receive a message from a second reader by means of the radio transceiver. Depending on the content of the message the reader responds to the message by transmitting a modified message in a format that can be received by a second reader in the network.

A disadvantage of this solution is that the network structure in which the readers are included is of a static nature. Nodes, which otherwise would be difficult to access from a main node, can be reached by readers acting as repeater nodes. If a node drops out, or a node is added to the network, or if the transmitter-receiver conditions alter drastically in areas covered by the network, in the known system no automatic, dynamic alteration of the routing of messages through the network appears to be possible.

**Summary of the invention**

It is an object of the present invention to provide a communication unit for use in a communication network such as a telemetry network, which does not have the above drawbacks.

Another object of the invention is to provide a meter reading unit for use in a meter reading network, which does not have the said drawbacks.

It is a further object of the invention to provide a telemetry network for communication between a server and meter readers that does not have the said drawbacks.

The above objects and other advantages are obtained by means of the features that will be apparent in the following, independent patent claims.

Further advantageous features will be apparent in the dependent claims.

**A brief description of the drawings**

The invention will now be described in greater detail in the form of a preferred embodiment with reference to the drawings, in which:

fig. 1 is a block diagram for a telemetry network according to the invention,

fig. 2 is a block diagram for a meter reading unit according to the invention,

fig. 3 is a block diagram for a server-linked meter reading unit according to the invention,

fig. 4 is a block diagram for a server for use in a telemetry network according to the invention,

Fig. 5 is an illustration of a sequence for selection of nodes during routing in a telemetry network according to the invention.

## Detailed description of the invention

Fig. 1 illustrates a block diagram for a telemetry network according to the invention. A server 10 communicates via a connection 80 with a server-linked meter reading unit 100a. The connection 80 may comprise a fixed line such as an optical fibre connection, ISDN or analog line, a mobile network such as GPRS, GSM/SMS, UMTS, etc., a radio network or power line communication (Power Line Communication, PLC).

The server 10 may communicate with a plurality of server-linked meter reading units 100a via additional connections 80 (not shown in fig. 1).

Additional servers 10a, 10b may be arranged to communicate with the server 10 via high-speed connections 70.

The server-linked meter reading unit 100a communicates in turn via a radio-based connection 90 with one or more meter reading units 100. Each meter reading unit 100 is arranged to communicate via radio-based connections 90 with an additional one or more meter reading units 100.

Each meter reading unit 100, 100a is arranged for optical reading of a utility meter, such as a meter switchboard for registering consumption of electrical energy. Each utility meter may be contained in a meter switchboard, which is associated, e.g., with a house or a building.

Each meter reading unit is arranged to communicate with other meter reading units, in order thereby to form a dynamically constructable communication network where different communication paths through the network can be established. Each individual meter reading unit need not communicate directly with the central server 10, nor directly with the radio access point, i.e. the server-linked meter reading unit 100a.

Fig. 2 illustrates a block diagram for a meter reading unit 100 according to the invention.

The meter reading unit 100 comprises an input unit 110 and a communication unit 120.

The input unit 110 is arranged to provide entry data to an entry port on the microcontroller 132. For this purpose, in a preferred embodiment the input unit 110 comprises an optical sensor arranged to image a series of numbers on an existing energy meter, and to convert the image to digital data.

The communication unit 120 comprises a control module 130 and a transceiver module 140.

The control module 130 comprises a microcontroller 132 with a program memory 136 and a data memory 138.

The program to be executed by the microcontroller 132, contained in the program memory 136, comprises a module for image processing, whereby image data input from the input unit 110 are converted to numerical values, and a module for communication control that supports a communication protocol for communication between the communication unit 120 and a second, corresponding communication unit 120 operating in the network.

The transceiver module 140 comprises a radio controller 142, a radio transceiver circuit 144 and an amplifier/antenna division circuit 146. The radio controller controls the transceiver circuit and comprises a memory containing data concerning the radio communication's frequency, band width, power, modulation, etc. The transceiver circuit 144 contains a transmitter and a receiver, arranged to transmit and receive respectively on a frequency and with a modulation indicated by the radio controller 142.

The program to be executed by the microcontroller 132, stored in the program memory 136, further comprises instructions for enabling the meter reading unit 100 to communicate wirelessly with other meter reading units 100 by means of a packet-based protocol. In order to achieve the routing in the network, a data packet, a so-called inquiry message, is transmitted, containing information on the originator's identity and geographical position, the destination's identity and geographical position together with error-correcting codes. This information is processed by a second, receiving meter reading unit 100 in the network in order to guide the packet in the right direction. This receiving meter reading unit computes its distance to a straight line between originator and destination (course deviation data), and

acknowledges by returning a response message containing data concerning this distance, data concerning received signal strength and its own power level in addition to addresses and error codes (acknowledged/not acknowledged). If the distance is greater than a set limit, no response message is returned.

One of the consequences of the invention is that the total transmission power is set at a minimum at all times, thus generating the least possible signal and noise for other meter reading units 100 which are not participating at the moment.

Data concerning geographical position are stored in the data memory 138 in the meter reading unit. These data may have been created in various ways:

1. The fitter who installs the meter reading unit 100 is equipped with a control unit that has the same functionality as a radio access point, i.e. a server-linked meter reading unit 100a. This gives the fitter the opportunity of both programming a meter reading unit 100 and communicating with the meter reading unit, particularly adding geographical data via the nodes (the meter reading unit) in the area round the installation points.

2. The data can be retrieved from the server 10, which has such data stored in its database 12 for meter data. A unique series number for the meter reading unit 100 must then have been made accessible to the server 10. This is particularly relevant in cases where the meter reading unit 100 has lost all or parts of its short-term memory.

3. During the installation of a meter reading unit 100 the fitter uses a mobile terminal, e.g. a GPRS terminal. This terminal communicates directly with the server 10, which in turn will take care of the installation routines utilised by the network. A message is generated and transmitted that includes, inter alia, data for the geographical position of the newly installed meter reading unit 100. When the meter reading unit 100 has received its geographical position from the server 10, this information will be integrated in the protocol and used in subsequent communication in the network.

4. During the installation the fitter employs a GPS unit and a hand-held controller unit (see alt. 1). The geographical position data are

transmitted to each meter reading unit 100 during installation by the fitter inputting data from the GPS unit and transferring them to the meter reading unit 100 by means of the hand-held controller unit.

By means of transmission through the network, each meter reading unit 100 has also received data for the geographical position of the closest server-linked meter reading unit 100a. These data are stored in the data memory 138 in the meter reading unit 100.

The meter reading unit 100 may also include additional signal inputs on the microcontroller 132 (not shown) for connecting to external signal sources. Such inputs may, e.g., be used for transferring data associated with weather conditions (signal from a barometer, a precipitation indicator, etc.), alarm outputs (fire alarm, burglar alarm), camera equipment for transmitting pictures in the event of a break-in, etc.

In particular, the meter reading unit 100 may comprise a temperature sensor (not shown), connected to a signal input on the microcontroller 132. A sensor of this kind may be used for detecting fire or signs of a fire, and the network can be used for effective warning thereof. Alternatively, another known per se sensor may be used for smoke or gas formation. A sensor of this kind integrated in the meter reading unit permits an efficient remote warning of fire/signs of fire without installation of additional cables or components.

The meter reading unit 100 may also comprise signal outputs on the microcontroller 132 for connecting to external control units. These outputs can be used to control external processes, such as supplying control current to a contactor in order to switch a hot water tank off and on.

By means of additional extra modules connected to the microcontroller 132, the meter reading unit 100 may be connected to other, external telecommunication and data communication equipment. This permits the meter reading unit 100 to be linked up to various separate security systems such as, e.g., fire and burglar alarms, or possibly control and/or metering equipment associated with smart house solutions, etc.

Fig. 3 illustrates a block diagram for a server-linked meter reading unit 100a according to the invention. The server-linked meter reading unit 100a is substantially identical to the meter reading unit 100 described above in connection with fig. 2, but it also includes a circuit 134 that permits direct communication with a server 10. The circuit 134 preferably comprises an interface to the telecommunication network, such as a fibre interface, or alternatively a GPRS interface, SMS interface, ISDN interface or an analog modem for fixed line. The program contained in the program memory 136 for execution of the microcontroller 132 further comprises a module for supporting the communication with the server 10.

Fig. 4 is a block diagram for a server for use in a communication system according to the invention.

The server 10 is arranged to attend to security and communication flow in the network. This is achieved by the server 10 and the individual meter reading unit 100 encrypting all useful data transmitted via the network and by the server 10 performing continuous measurements that form the basis for the network's status and traffic volume within a given period. This statistic is employed for controlling parameters in those parts of the network that have the greatest traffic density, thus providing the best possible distribution in time and area in relation to the network's capacity.

The meter reading units that are located closest to a server-linked meter reading unit 100 are subject to greater traffic volume than those located at other points in the radio network, and it is in these areas that the regulation of parameters will yield the greatest benefits.

In addition, the server 10 performs all registration of data, logging of activities and service routines.

The server 10 comprises a processing unit 30 connected to a program memory 34 and a data memory 32. The server 10 further comprises a database controller 16 and a radio network controller 18, both connected to the processing unit 30.

The database controller 16 is furthermore connected to a database 12 for meter data. The database 12 stores and contains information derived from each meter reader, such as meter reading, time of reading and status of the meter unit 100. In addition to this information, in the database 12 there is

fixed storage of the geographical position of the meter unit 100 and the series/measuring point/installation number on which the location of the meter unit 100 is based.

The database controller 16 is arranged to handle communication between the processing unit 30 and the database 12 for meter data. It is arranged to act as a common interface to different database formats, and to permit simple upgrading and/or extension of the database 12.

The radio network controller 18 is also connected to a database 14 for radio network data. The radio network controller 18 is further connected to at least one radio access point controller 20. The radio access point controller 20 forms the link between the radio network controller 18 and each server-linked meter reading unit 100a. As illustrated in fig. 4 the individual radio access point controller 20 may be located inside or outside the server 10.

The database 14 for radio network contains logged information concerning all activity and all parameters included in the network. This information is used in a continuous process for regulating the radio network's dynamic range and capacity.

The radio network controller 18 is arranged for operation of the entire radio network. In practice, this unit has similar functionality to an MSC (Mobile Service Switching Centre) in GSM systems. This unit has a logic block control, which is logically independent of physical location.

The processing unit 20, the data memory 32 and the program memory 34 constitute an ordinary data system such as a PC.

Fig. 5 illustrates how nodes are selected during dynamic routing in a telemetry network according to the invention. In the following, the term "node" in the network should be understood to refer to a communication unit 120 that either forms part of a meter reading unit 100 or a server-linked meter reading unit 100a.

In figure 5 it is assumed that a node designated RECAPS-A will be understood to refer to a communication unit 120 in a meter reading unit 100. RECAPS-A is the originator node for a message, designated main message, which has to be transmitted to a destination node. The

destination node is designated RECAPS-RAP, and should be understood to refer to a communication unit 120 in a server-linked meter reading unit 100a.

In an area between the originator node RECAPS-A and the destination node RECAPS-RAP, there are a number of intermediate nodes RECAPS-B, RECAPS-C, RECAPS-D, RECAPS-E. Each of these is a communication unit 120 in a meter reading unit 100.

The originator node RECAPS-A has stored in its memory data for an identification and the geographical position of the destination node RECAPS-RAP. These data are supplied to each node during installation.

The following steps 1-18 illustrate this sequence:

1. RECAPS-A verifies that the radio channel is idle.

2. The originator node RECAPS-A transmits on the radio an inquiry message whether there is a node that can receive a message intended for RECAPS-RAP in a specific position. In the inquiry message, identification and position for RECAPS-A is indicated.

3. Every node that intercepts the inquiry message from the originator node RECAPS-A decodes the message and extracts data concerning the position of originator RECAPS-A and destination RECAPS-RAP. The node then calculates whether its own position lies within an allowed distance from the straight line between originator RECAPS-A and destination RECAPS-RAP.

4. If the node in question satisfies the distance condition, on the basis of further conditions concerning received radio signal strength and bit error rate for the received signal, together with its own operative condition in the network, it will transmit a response message back to the originator RECAPS-A. The response message contains the node's identity and position, the signal strength on which it heard RECAPS-A, and the node's own status in the network. It also reports how many jumps it has into the indicated destination RECAPS-RAP, if it has collected this information internally by means of the controller 132. As an alternative to the number of jumps, the response message may contain information on distance from the node to the destination,

calculated by means of the controller 132.
The response message is transmitted with a time delay that is dependent on the distance between the node and RECAPS-A. The greater the distance, the shorter the delay. This helps to avoid collisions between response messages and to balance the radio load in the network as a whole.

5. The originator node receives response messages from the node in question and any other nodes that have transmitted a response message. Those nodes that transmit a response message are regarded as possible candidates to become the best node in the routing. The received response messages are decoded, and on the basis of data extracted from the response message concerning the individual node's position, received radio signal level and received bit error rate, one of the nodes is selected as next node in the routing.

6. RECAPS-A transmits a main message to the node that has been selected in point 5. The other nodes, which have sent a response message and which, moreover, hear this message, will enter standby mode. With reference to figure 5, RECAPS-B will take responsibility for the main message and acknowledge to RECAPS-A that it has received the main message. In the case of excessive error rate, RECAPS-B will request a new transmission of the message.

7. RECAPS-B now has responsibility for forwarding the message to the destination node RECAPS-RAP. The originator node RECAPS-A will keep its information about the message until the destination node RECAPS-RAP transmits a received message to the originator node RECAPS-A.

8. When the node RECAPS-B has received a message, which it has to forward, it will start by verifying that the radio channel is vacant, whereupon it will transmit on the radio an inquiry message whether there is anyone who can receive a message that is intended for RECAPS-RAP in a specific position. In this inquiry message the identity and position of RECAPS-B are indicated. The original originator identity and position of RECAPS-A will now be a part of the message that has to be forwarded.

9. The originator node RECAPS-A will not respond to the inquiry message transmitted in step 9, since its own identity or position agree with corresponding data in the originator address in the message.

10. With reference to fig. 5, the nodes RECAPS-C and RECAPS-D will respond to the inquiry message transmitted in step 9. In both cases what applies is that if the node is to be able to respond it must transmit a response message containing inter alia data representing the distance between the node's own position and the straight line between the originator node RECAPS-A and RECAPS-RAP. The response message also contains data concerning received radio signal strength, bit error rate, etc. in the same way as the response message described under point 4 above.

11. In this example the three nodes RECAPS-C, RECAPS-E and RECAPS-D will report back to RECAPS-B that they can receive the message. RECAPS-D reports that it has 1 jump into RECAPS-RAP and the quality of transmitter/receiver conditions is good. RECAPS-E reports back that it has 1 jump in, but has poor transmitter/receiver conditions. RECAPS-C reports that it has 2 jumps into RECAPS-RAP and has good transmitter/receiver conditions.

12. RECAPS-B receives response messages from RECAPS-C, RECAPS-E and RECAPS-D and decodes these messages, thereby providing inter alia data concerning the individual node's position, received radio signal level and bit error rate on the node's received signal. On the basis of these data, RECAPS-B determines which node should be the next in the routing. In this example RECAPS-C will be selected as next node.

13. RECAPS-B transmits the main message to RECAPS-D. RECAPS-D sends an acknowledgment back to RECAPS-B and subsequently takes responsibility for transmitting the main message to the destination RECAPS-RAP.

14. If the main message has to pass through several nodes on its way to the destination node RECAPS-RAP, the routing function will be similar to that described in points 8 to 13 inclusively.

15. In our example it is RECAPS-RAP that is the next node in the routing, and RECAPS-D will transmit an inquiry message whether there is anyone who can forward the main message. RECAPS-RAP will reply in the normal manner with its own identity, position and data for received radio signal level and bit error rate, and if possible number of jumps to the destination node RECAPS-RAP (in this case the number is zero).

16. When RECAPS-D has forwarded the message, it will transmit a report message to WRC-B that the message has been forwarded, so that WRC-B can delete the main message in its own memory.

17. When RECAPS-RAP has received and approved the main message, it will give a message to the preceding node in the routing (in the example: RECAPS-D) to the effect that the main message can be deleted in the preceding node. RECAPS-RAP is now responsible for forwarding the message to the server 10.

18. When RECAPS-RAP has received acknowledgment back from the server 10, RECAPS-RAP will delete the main message in its own memory and transmit an acknowledgment message back to the originator node RECAPS-A expressing that the transmission has been implemented.

The dynamic range in the resulting network is self-regulating, with the result that the routing will be changed in the event of any disturbances or changes in signal levels or if any physical obstacles interfere with the signal. The packets may, e.g., circumvent an obstacle (large house, mountain) by means of this dynamic range.

On the basis of the above, those skilled in the art will realise that a dynamic routing sequence may be obtained in a similar fashion from a server for a server-linked originator node to an arbitrary destination node in the network, or from an arbitrary, first originator node in the network to an arbitrary, second destination node in the network.

Those skilled in the art will also realise that there are obvious alternatives to a number of the detailed features illustrated as examples in the description.

For example, the individual meter reading unit 100, 100a may be arranged to count pulses from the utility meter instead of reading a series of numbers. For this purpose the input unit 110 is a single adapter circuit for received pulses, and the module for image processing in the program executed by the microcontroller 132 is replaced by a single program module for counting pulses.

As an alternative to the connection 90 being radio-based, the connection 90 may be established by means of overlaying of the communication signal on a power line. This may be particularly suitable where a great many meter reading units 100 are located at places which have common power supply lines, such as in high-rise buildings or terraced houses.

In other respects, those skilled in the art will realise that many modifications and variations are possible within the scope of the invention, as it is defined by the following patent claims and their equivalents.

## PATENT CLAIMS

1 A communication unit (120) for use in a communication network such as a telemetry network, comprising
a radio transceiver (140) and a controller (130) with a memory (136, 138), where the controller (130) is arranged to
- receive an inquiry message from a second communication unit (120) in the network by means of the transceiver (140) and
- decode the inquiry message,
characterised in that the said memory (136, 138) contains
- position data concerning the communication unit's (120) geographical position,
that on decoding the message the controller is arranged to derive
- position data concerning an originator's geographical position and
- position data concerning a destination's geographical position,
that on the basis of these position data the controller is further arranged to calculate course deviation data representing the distance from the communication unit's own position to a straight line between the originator's and the destination's positions, and that the controller (130) is further arranged to transmit a response message comprising the said course deviation data back to the said second communication unit (120) by means of the transceiver (140).

2. A communication unit (120) according to claim 1, where the said response message also comprises data representing a level for the radio signal received by the transceiver (140).

3. A communication unit (120) according to one of the claims 1-2, where the said response message also comprises data representing a bit error rate for the radio signal received by the transceiver (140).

4. A communication unit (120) according to one of the claims 1-3, where the controller (130) is further arranged to
- transmit the said response message only if the said course deviation data express that the said distance is less than a given limit value.

5. A communication unit (120) according to one of the claims 1-4, where the said response message also comprises data expressing the communication unit's (120) operative state in the network.

6. A communication unit (120) according to one of the claims 1-5, where the controller is further arranged to transmit the said response message after a time delay that is dependent on the communication unit's (120) position.

7. A communication unit (120) according to claim 6, where the time delay is also dependent on the originator's geographical position.

8. A communication unit (120) according to claim 7, where the time delay is greater the less the distance between the communication unit's (120) and the originator's position.

9. A communication unit (120) according to one of the claims 1-8, where the controller (130) is further arranged to
- receive a response message from each of a number of communication units (120) in the network by means of the transceiver (140),
- decode the response messages, and
- on the basis of data derived from the response messages, determine which of the communication units (120) should be selected as a receiver for a transmitted main message.

10. A meter reading unit (100) for use in a meter reading network, comprising an input device (110) for input of values from a meter device,
characterised in that it further comprises a communication unit (120) as indicated in one of the claims 1-9.

11. A meter reading unit (100) according to claim 10, where the controller (130) is arranged to transmit by means of the transceiver (140) a message containing data generated by the input device (110).

12. A meter reading unit (100) according to one of the claims 10-11, where the input device (110) comprises an optical sensor arranged

to image a series of numbers displayed on a meter, and where the controller (130) is arranged to convert optically read data to numerical values.

13. A meter reading unit (100) according to one of the claims 10-12, further comprising equipment (134) for direct communication with an external server (10).

14. A meter reading unit (100) according to one of the claims 10-13, further comprising inputs to the controller 130 for input of signals from a signal source.

15. A meter reading unit (100) according to claim 14, where the signal source is a temperature sensor contained in the meter reading unit.

16. A telemetry network, particularly a meter reading network, characterised in that it comprises at least one server (10), at least one server-linked meter reading unit (100a) and at least one meter reading unit (100) according to one of the claims 10-15.

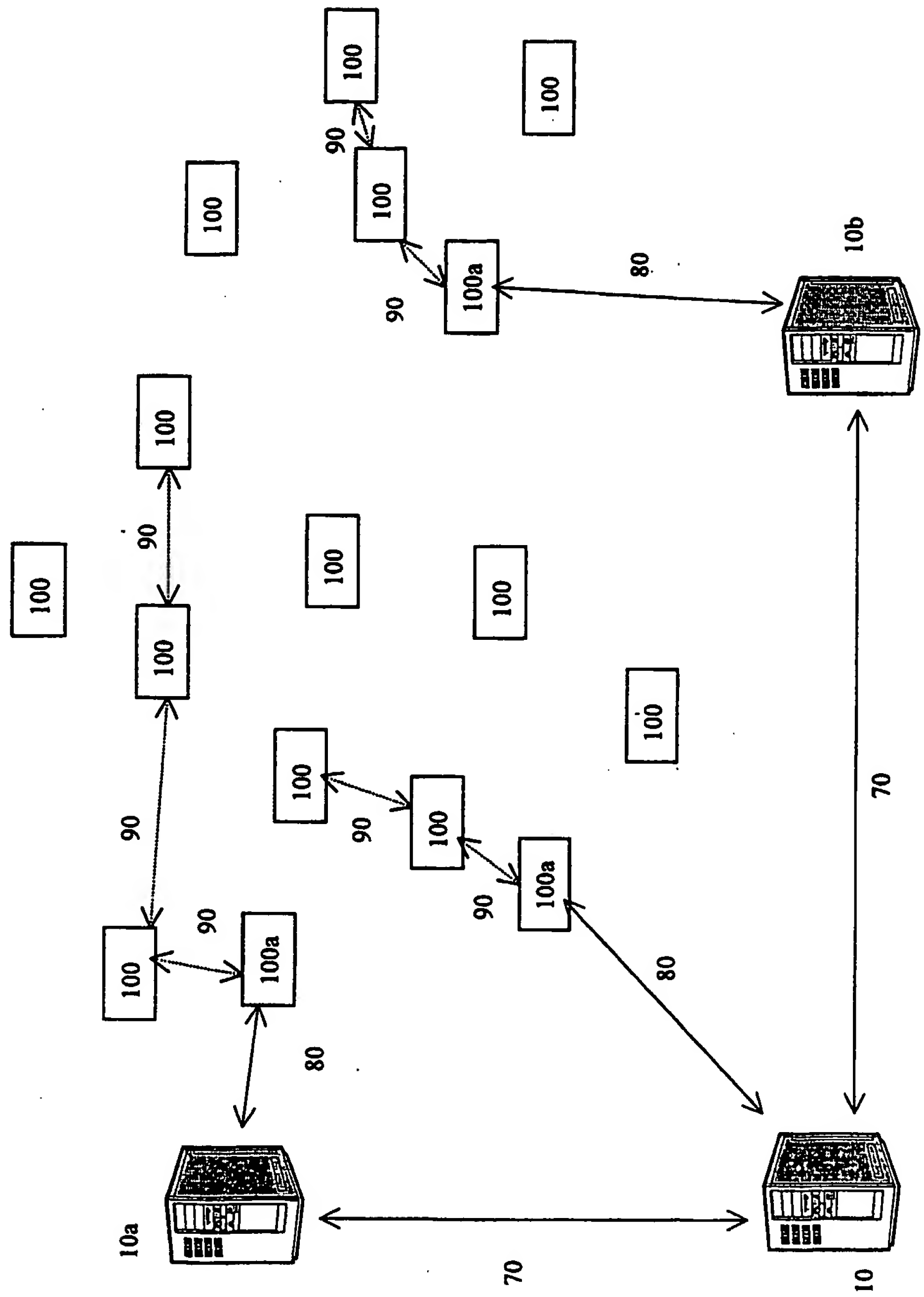



Fig. 1

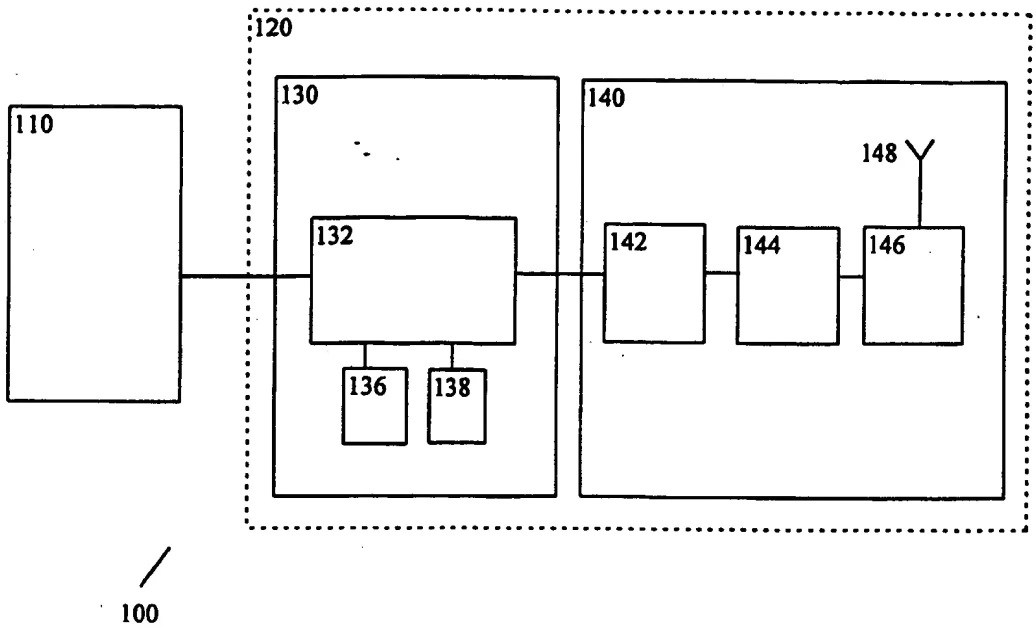



Fig. 2

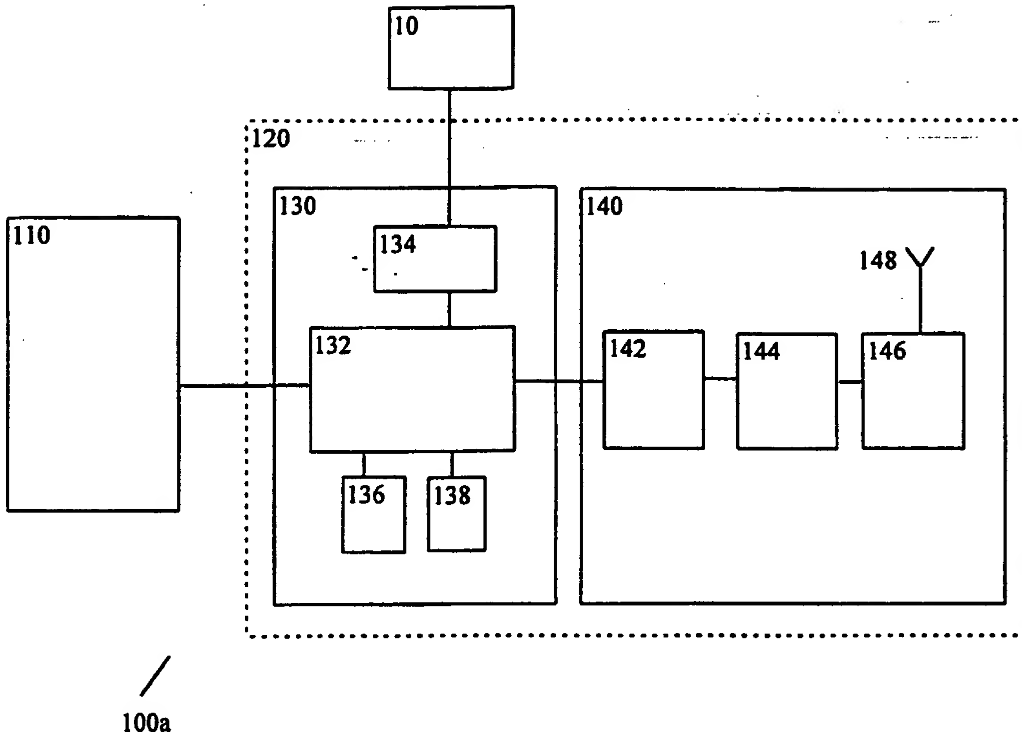
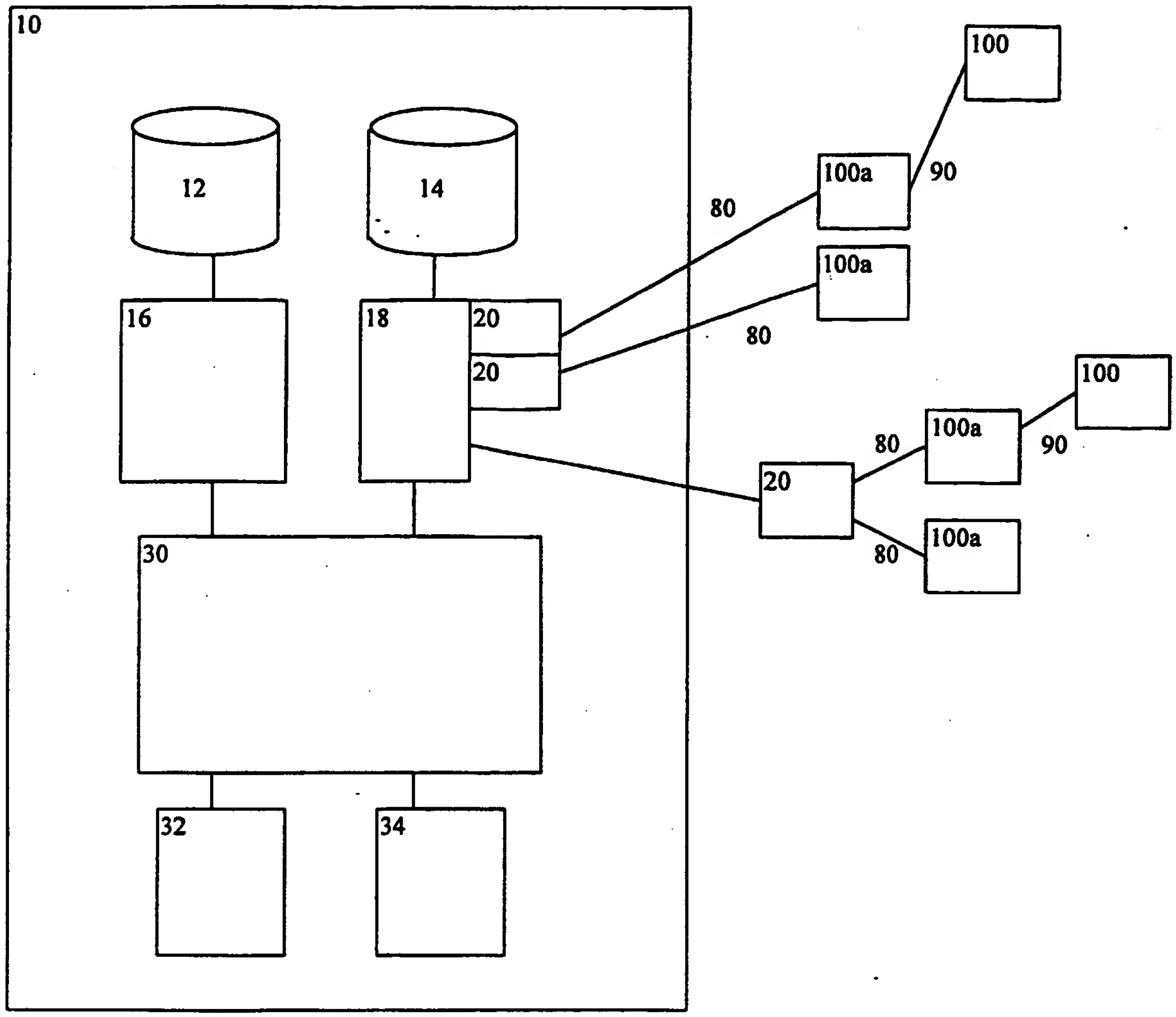



Fig. 3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90
20

Fig. 4

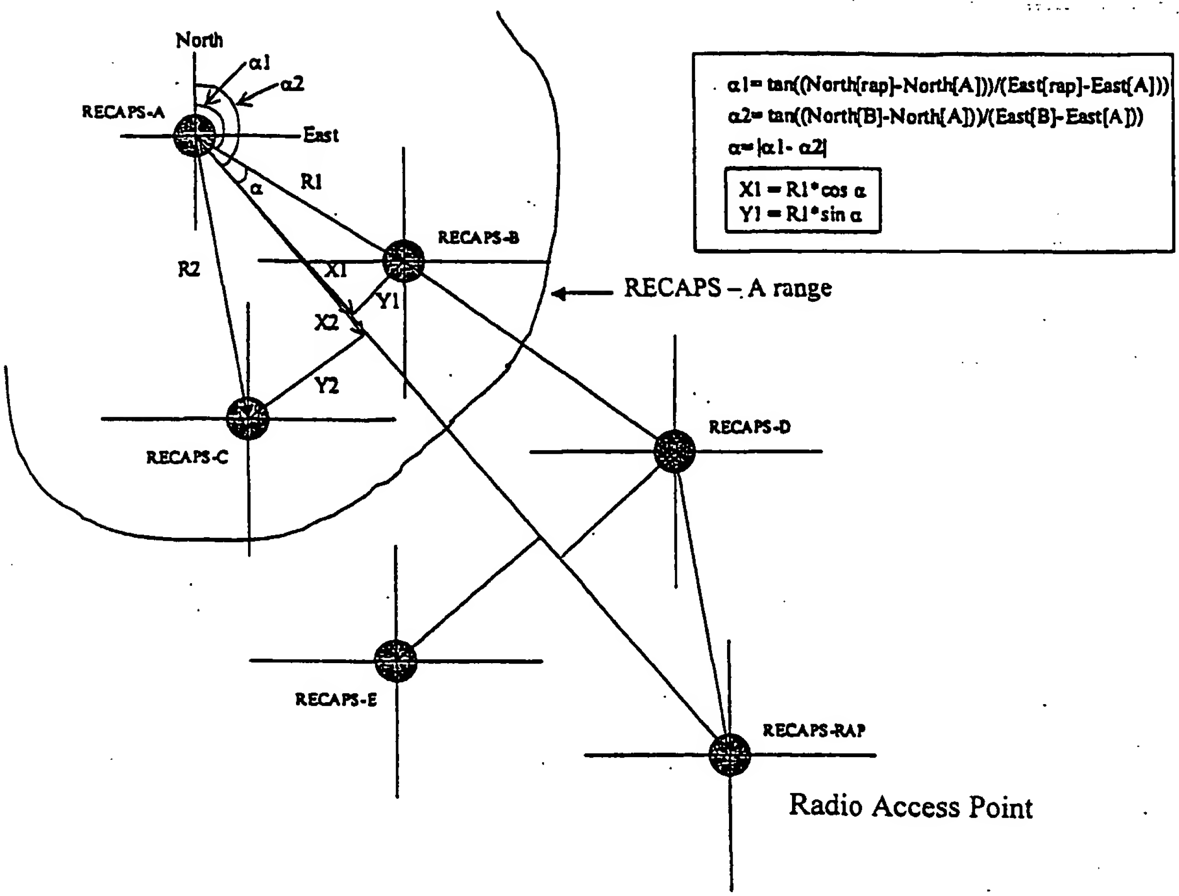
North
α1
α2
RECAPS-A
East
α
R1
R2
RECAPS-B
X1
Y1
X2
Y2
RECAPS-C
RECAPS – A range
RECAPS-D
RECAPS-E
RECAPS-RAP
Radio Access Point
α1= tan((North[rap]-North[A]))/(East[rap]-East[A]))
α2= tan((North[B]-North[A]))/(East[B]-East[A]))
α= |α1- α2|
X1 = R1*cos α
Y1 = R1*sin α

Fig. 5

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 02/00278

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 12/28, H04B 7/15 // H04Q 9/00, G08C 17/02
According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04L, H04Q, G08C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | IEEE Network, Volume 11, November 1997, Guthery, S., "Wireless relay networks", Page 48, right hand column, line 28 - page 49 left hand column line 13. Page 50"Adding and deleting nodes" | 1-16 |
| | -- | |
| X | WO 9946899 A2 (SWISSCOM AG), 16 Sept 1999 (16.09.99), figure 1, abstract | 1-9 |
| A | | 10-16 |
| | -- | |
| X | WO 0155865 A1 (TELEMETERY TECHNOLOGIES, INC.), 2 August 2001 (02.08.01), page 14, line 15 - page 18, line 29 | 1-16 |
| | -- | |

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 10 January 2003 | 13-01-2003 |
| Name and mailing address of the ISA/<br>Swedish Patent Office<br>Box 5055, S-102 42 STOCKHOLM<br>Facsimile No. +46 8 666 02 86 | Authorized officer<br>Åsa Hällgren/mj<br>Telephone No. +46 8 782 25 00 |

INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 5874903 A (KENNETH C. SHUEY ET AL), 23 February 1999 (23.02.99), figure 5, abstract<br>--<br>-------- | 1-16 |

# INTERNATIONAL SEARCH REPORT
Information on patent family members

01/12/02

International application No.
PCT/NO 02/00278

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
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| | | AU 1234799 A | 27/09/99 |
| | | CA 2321918 A | 16/09/99 |
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| | | EP 1064760 A,B | 03/01/01 |
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| | | US 2002094799 A | 18/07/02 |
| US 5874903 A | 23/02/99 | AU 7714198 A | 21/12/98 |
| | | GB 2340645 A,B | 23/02/00 |
| | | GB 9927652 D | 00/00/00 |
| | | WO 9855975 A | 10/12/98 |